EaglePicher

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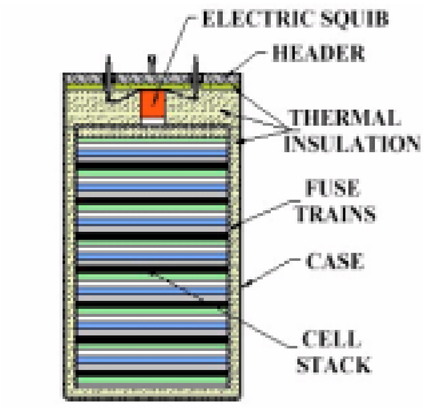
# Thermal Battery Design




A thermal battery provides relatively high energy density vs. volume. With a hermetic seal in place, it can be stored indefinitely without degradation of performance and will perform without preliminary preparation under a variety of environments. It is therefore an excellent power supply for applications having these restraints.

The electrochemical system used for most thermal batteries is an iron disulfide cathode with a lithium alloy anode. Its advantages include: substantial power density, low and uniform internal impedance while active, minimal noise, and adaptability to a broad spectrum, of environments.

The configuration of a thermal battery is dictated by mechanical and thermodynamic considerations and is generally a right circular cylinder. Mechanically, since the cell stack components are rigid and brittle, the stack is sealed under mechanical pressure for dynamic environment considerations such as shock, vibration, and acceleration. Thermodynamically the configuration must be an efficient retainer of heat. The right circular cylinder provides the optimum ratio of internal volume to surface area and the best heat retentive properties, and therefore a cylindrical configuration is utilized if possible.

The electrolyte is a eutectic mixture composed of inorganic salts. The eutectic electrolyte is the basis for many of a thermal battery's desirable characteristics. The material is completely inert and nonconductive until the battery is activated at which time it becomes molten and highly conductive. This allows the cathode to interact with the anode.

The thermal source will be a mixture of iron powder and potassium perchlorate. Ignition of the thermal source supplies the energy to melt the electrolyte and allow the battery to become active. The material is also conductive and serves as a connector between the cells. Ignition of the thermal energy source is generally accomplished by a pulse to an electrical initiator or by mechanically striking a percussion primer. EaglePicher also manufactures an inertial igniter, which will ignite the battery when subjected to a certain force.

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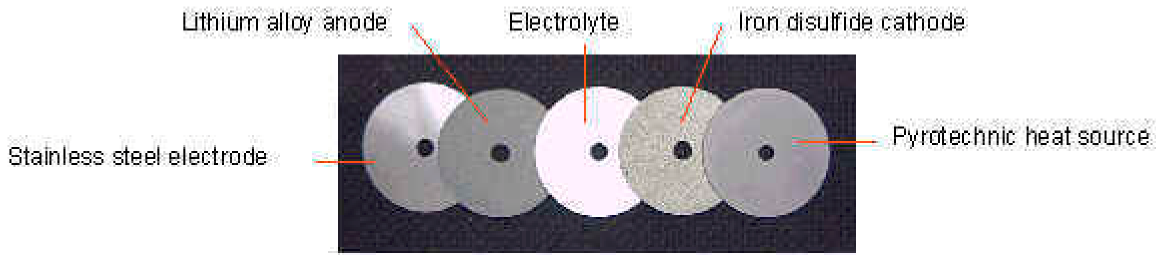
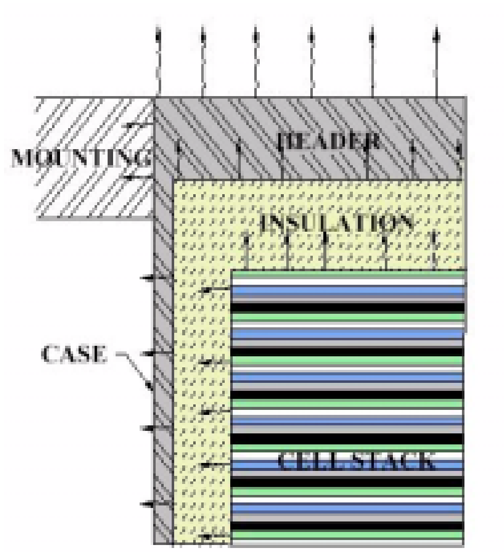



The various cell components briefly described above begin as powders. The powders are pelletized to carefully controlled weight and density. The components are then stacked sequentially in order to provide a stack of cells, electrically in series, sufficient to provide the desired battery voltage. A single cell of the type described is diagrammed in the figure above.

As power density and volume requirements dictate, a thermal battery may consist of a single series stack of cells or of two or more parallel stacks of series cells. The cell stack(s), insulated as thoroughly as possible, are placed in a stainless steel container and the container is welded closed to form a hermetic seal. Electrical connections are provided through standard glass to metal seals.




Once activated the battery will continue to function until a critical active material is exhausted or until the battery cools below the melting point of the electrolyte. It is therefore important that the battery be well insulated; insulation also reduces the external temperature of the battery because heat is lost more gradually. The activated battery is somewhat more sensitive to environments; however, it will still function efficiently under substantial shock, vibration and acceleration. Once activated the battery will climb rapidly to a peak voltage, which will decline gradually during the remainder of the active life.